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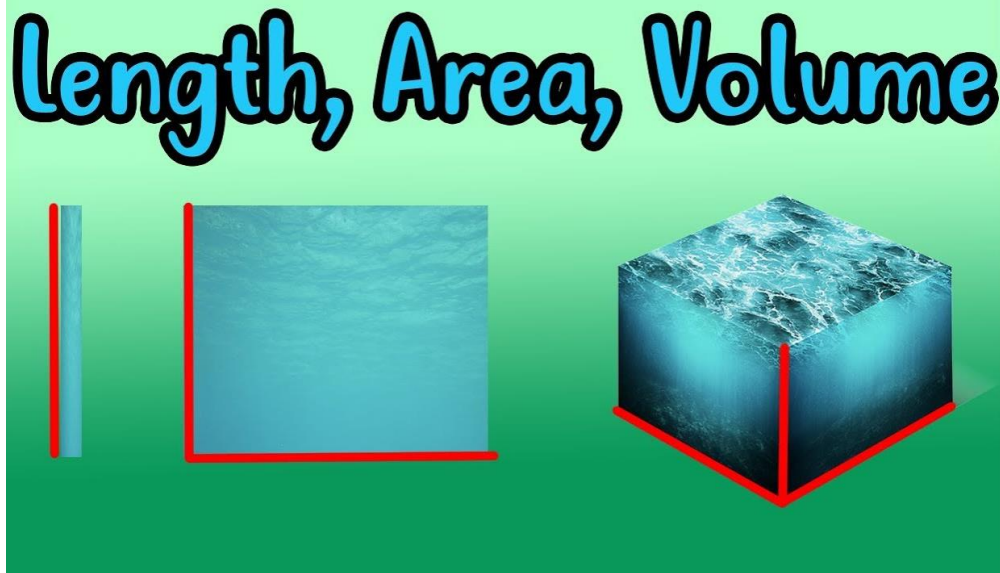


P5 Integrated Science

Term 1

THEME: MATTER AND ENERGY

Topic 2/4: Measurements



Measuring length

The standard unit of length is metres (m).

Other metric system units include

Millimeter (mm) = 0.001m or $\frac{1}{1000}m$ or $10^{-3}m$

Centimetres (cm) = 0.01m or $\frac{1}{100}m$ or $10^{-2}m$

Kilometer (km) = 1000m or 10^3m

Exercise 1

List 3 metric units of length

Tools for measuring length

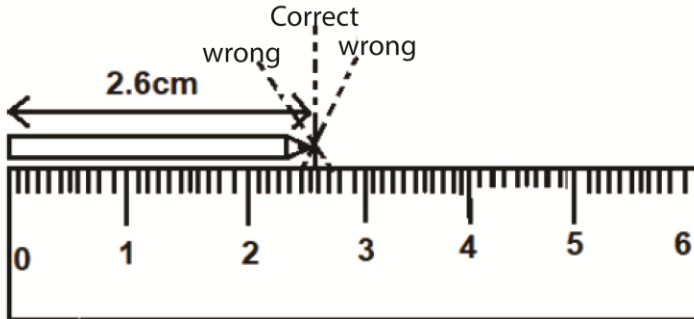


Exercise 2

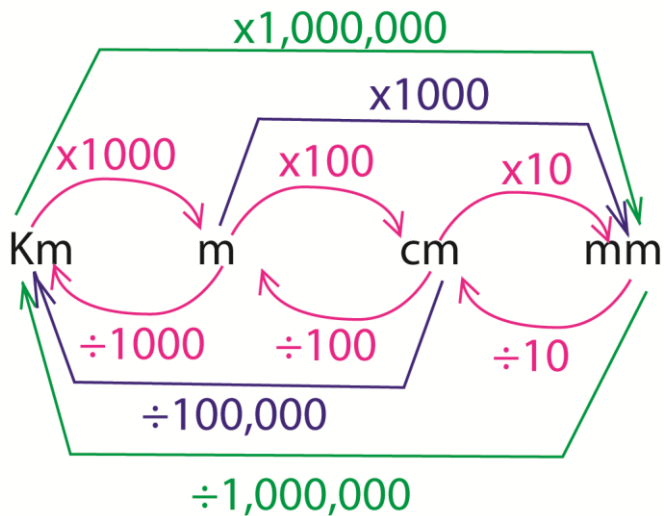
List any 3 tools of measuring length

Accurate measurement using a ruler

To accurately take a reading, the eye must be right over the mark on the scale as show below



Conversion of units



Example 1

Convert

- (a) 3m to cm
 $3\text{m} = 3 \times 100 = 300\text{cm}$
- (b) 2km to mm
 $2\text{km} = 2 \times 1,000,000 = 2,000,000\text{mm}$
- (c) 35000cm to km
 $35000\text{cm} = \frac{35,000}{100,000} = 0.35\text{km}$
- (d) 100,000m to km
 $100,000\text{m} = \frac{100,000\text{m}}{1,000} = 100\text{km}$

Exercise 3

1. Name 3 tools used to measure length
2. Convert the following to metres

- (a) 10mm
- (b) 5cm
- (c) 4km
- (d) 2000cm

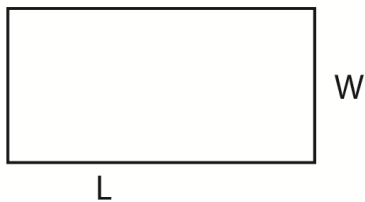
3. Convert the following as instructed

- (a) 2m to cm
- (b) 30cm to mm
- (c) 0.5km to mm
- (d) 500mm to km
- (e) 20cm to m

Area

This is the amount of space an object occupies.

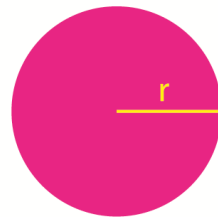
Formulae for finding area of common shapes



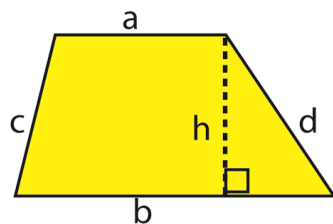
Rectangle: $L \times W$



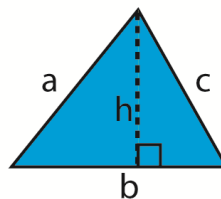
Square = a^2



Circle = πr^2



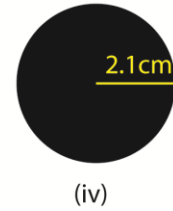
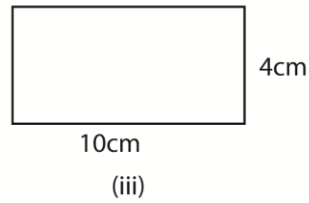
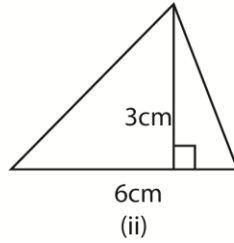
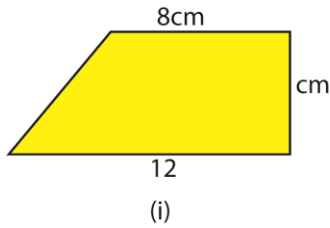
Trapezium = $\frac{1}{2}(a+c) \times h$



Triangle = $\frac{1}{2}(b \times h)$

Exercise 4

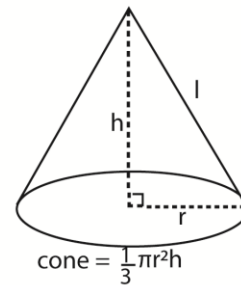
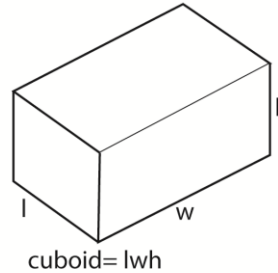
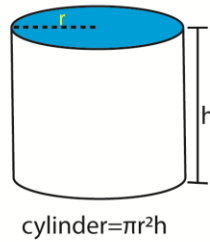
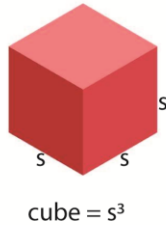
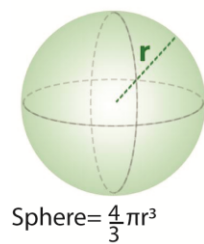
Find the area of each of the following:



Volume

Volume is the **amount of space** that an object or substance occupies. It is measured in **cubic units** such as cubic centimeters (cm^3), cubic meters (m^3), or liters (**L**).

Formulae for volumes of common shapes



Exercise 4

Find the volume (take $\pi = 22/7$)

- (i) a sphere of radius $r = 14\text{cm}$
- (ii) a cube of side, $s = 4\text{cm}$
- (iii) a cylinder of radius $r = 7\text{cm}$ and height 10cm
- (iv) a cuboid of dimensions 2cm by 6cm by 8cm
- (v) a cone of radius, $r = 35\text{cm}$ and height, $h = 6\text{cm}$.

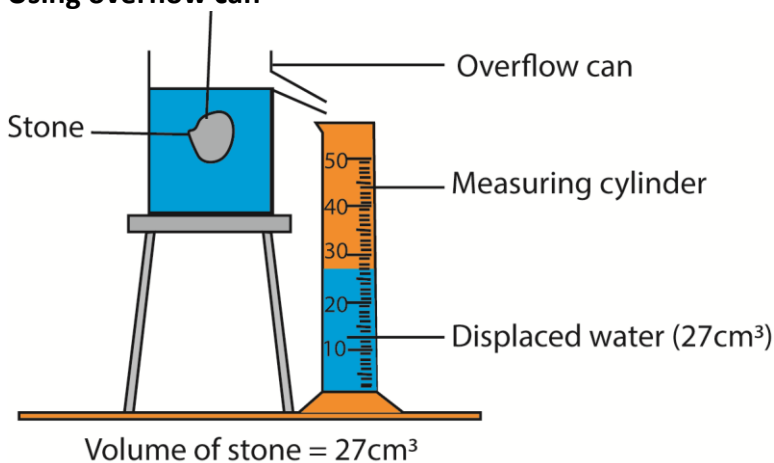
Measuring volume of irregular objects

(a) Water Displacement Method (For Solid Objects)

- (i) Half fill a **graduated cylinder** and record the initial volume.
- (ii) Submerge the **irregular object** completely in the water.
- (iii) Record the **new water level**.
- (iv) **Volume of object = Final Volume - Initial Volume.**



(b) Using overflow can



Step-by-Step Method

- (i) **Fill the Overflow Can:** Fill the can with water **until it just reaches the spout**. Let any excess water **drain out** to ensure an accurate measurement.
- (ii) **Submerge the Irregular Object:** Gently place the object into the water, ensuring it is **fully submerged**. The displaced water will flow out of the spout.
- (iii) **Collect the Overflow Water:** Place a **measuring cylinder** or another container under the spout to collect the displaced water. Be precise—avoid splashes or evaporation.
- (iv) **Measure the Volume** Read the **graduated scale** on the measuring cylinder.
- (v) The volume of the collected water is **equal to the volume of the object**.

Mass

Mass is the quantity of matter contained in the body. SI unit of mass is kilogram. Other units are grams, and tonnes.

Apparatus for measuring mass in school laboratories



Beam balance



Digital balance

Exercise 6

Convert the following to kg

- (i) 10mg
- (ii) 100g
- (iii) 500g
- (iv) 32.2g

Weight

Weight = Mass (kg) x Acceleration due to gravity ($=10\text{ms}^{-2}$)

= mg (where m = mass in kg, g = acceleration due to gravity = 10ms^{-2})

Weight is measured in Newton (N)

Example

Find the weight of

- (i) 2kg

Solution

$$\begin{aligned} W &= mg \\ &= 2 \times 10 \\ &= 20\text{N} \end{aligned}$$

(ii) 100g

Solution

$$100\text{g} = \frac{100}{1000} = 0.1\text{kg}$$

$$W = mg$$

$$= 0.1 \times 10$$

$$= 1\text{N}$$

(iii) 5000mg

Solution

$$500\text{mg} = \frac{500}{1000000} = 0.0005\text{kg}$$

$$W = mg$$

$$= 0.0005 \times 10$$

$$= 0.005\text{N}$$

Exercise 7

(a) Change the following masses to weight

(i) 80mg

(ii) 20g

(iii) 12kg

(b) Change the following weights to mass

(i) 40N

(ii) 0.2N

(iii) 4000N

Scientific notation (exponential or standard form)

Standard form is a way of writing very large or very small numbers concisely using powers of ten. It is commonly used in mathematics and science.

How to Write a Number in Standard Form

The format is: $a \times 10^n$

Where:

- a is a number between **1 and 9**
- n is the **power of 10** (positive for large numbers, negative for small numbers)

Examples

1. **Large number:**
 - 5,600,0005,600,000 → 5.6×10^6
 - The decimal point moves **6 places** to the left.
2. **Small number:**
 - 0.000420.00042 → 4.2×10^{-4}
 - The decimal point moves **4 places** to the right.

Exercise 8

Write the following number in scientific notation

- (i) 0.00009
- (ii) 4500000
- (iii) 0.049
- (iv) 527200

Density

It mass per unit volume

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

Example

- (a) 500cm^3 of a liquid has a mass 600g. Find the density of the liquid in kgm^{-3} .

Method I

$$\text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{600}{500} = 1.2\text{g/cm}^3$$

Method II

$$1\text{cm}^3 = 1\text{cm} \times 1\text{cm} \times 1\text{cm} = 10^{-2}\text{m} \times 10^{-2}\text{m} \times 10^{-2}\text{m} = 10^{-6}\text{m}^3$$

$$\therefore 500\text{cm}^3 = 500 \times 10^{-6} = 5 \times 10^{-4}\text{m}^3$$

$$1\text{g} = 10^{-3}\text{kg}$$

$$\therefore 600\text{g} = 600 \times 10^{-3} = 0.6\text{kg}$$

$$\text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{0.6}{5 \times 10^{-4}} = 1200\text{kgm}^{-3}$$

- (b) Find the density of a cube of side 40cm and mass of 600g.

$$40\text{cm} = \frac{40}{100} = 0.4\text{m}$$

$$\text{Volume of the cube} = l^3 = 0.4 \times 0.4 \times 0.4 = 0.064$$

$$600\text{g} = \frac{600}{1000} = 0.6\text{kg}$$

$$\text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{0.6}{0.064} = 9.375\text{kgm}^{-3}$$

Exercise 9

- Find the densities of objects below of
 - mass 2kg and volume 2m^3
 - mass 100g and volume 2cm^3
- Find the volumes of objects of
 - mass 5kg and density 1000kg/m^3
 - mass 50g and volume 2.5gcm^{-3}
- Find the masses of the following object
 - volume of 20m^3 and density of 7000kgm^{-3}
 - volume of 100cm^3 and density of 6g/cm^3

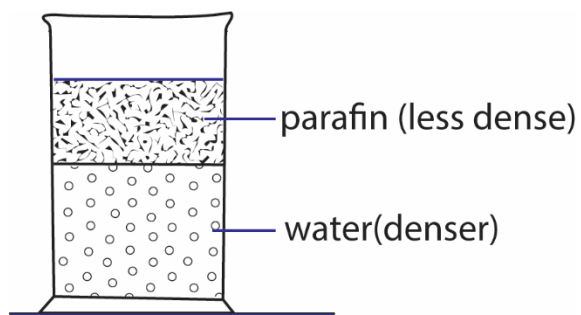
Floating and sinking in a liquid

A substance denser than a liquid **sinks** while that less dense than a liquid float,

A substance that sinks displaces amount of a liquid equal to its volume.

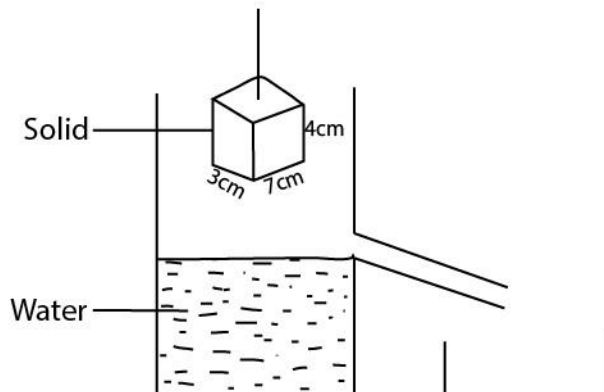
A substance **less dense** than a liquid **floats**.

For example stones, metals sink in water because it is denser than water while paraffin floats in water because it is lighter than water.



Exercise 10

The diagram below shows an experiment used to find the volume of a regular solid block. Use it to answer questions 1, 2, and 3.



1. What is the volume of the block?

$$\begin{aligned} \text{Volume} &= L \times W \times H \\ &= 3 \times 7 \times 4 \\ &= 84\text{cm}^3. \end{aligned}$$

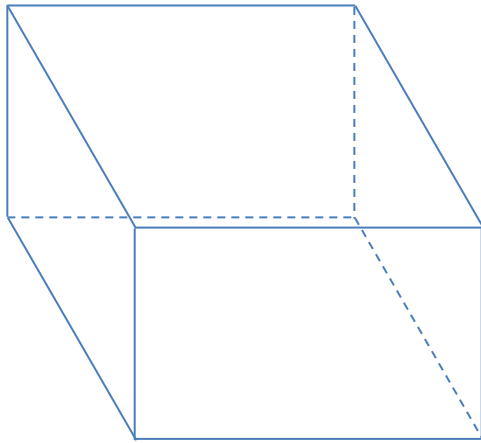
2. If the solid block is lowered into the overflow can, what volume of water will be displaced?

The volume equal to volume of the solid = 84cm^3 .

3. How would you confirm your answer in question 31 above?

By measuring the volume of water displaced using a measuring cylinder.

4. The figure below is accurately drawn. What is its volume?



Length = 4.6cm

Width = 3.4cm

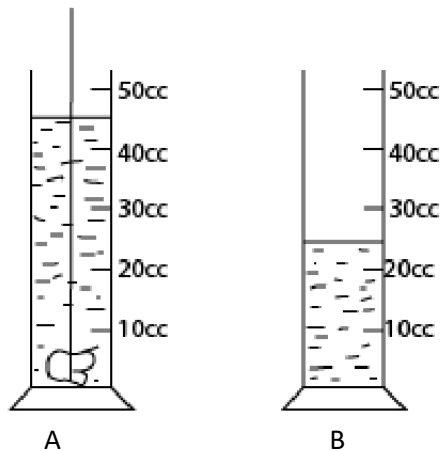
Height = 2.8cm

$$\begin{aligned}\text{Volume} &= L \times W \times H \\ &= 4.6 \times 3.4 \times 2.8 \\ &= 43.792 \text{ cm}^3\end{aligned}$$

5. Calculate the mass of an object whose volume is 15cm^3 and density is 30g/cm^3 .

$$\begin{aligned}\text{Mass} &= \text{density} \times \text{volume} \\ &= 30 \times 15 \\ &= 450\text{g}\end{aligned}$$

6. Use the diagram below to answer the questions that follow



(a) What is the volume of the stone?

$$45 - 25 = 20\text{cm}^3$$

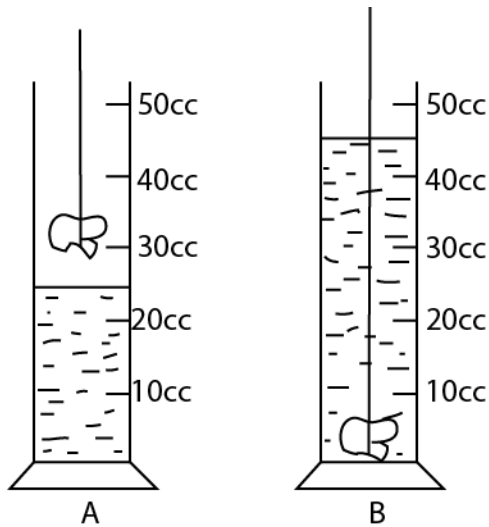
(b) Calculate the density of the stone if its mass is 450g.

$$\text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{450}{20} = 22.5 \text{ g/cm}^3$$

7. Find the density of an object whose mass is 10g and volume is 5cm³

$$\text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{10}{5} = 2 \text{ gcm}^{-3} \text{ or } 2 \text{ g/cm}^3$$

8. The diagram below is a method of measuring an irregular object. Study it and answer questions that follow.



(a) Calculate the volume of the stone.

$$\begin{aligned} \text{Volume of stone} &= \text{volume of water + stone} - \text{volume of water without stone} \\ &= 45 - 25 \\ &= 40 \text{ cm}^3 \end{aligned}$$

(b) Name the method used to find the volume.

Displacement method

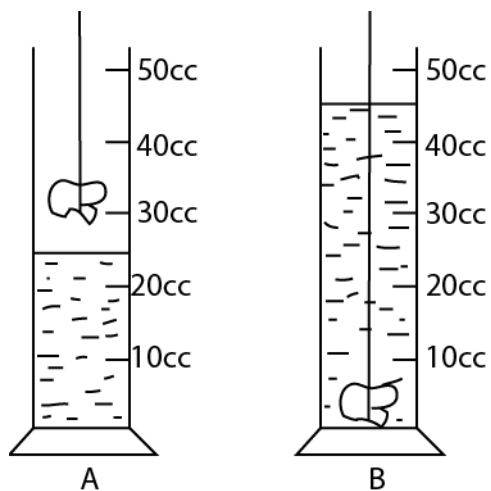
9. The diagram below shows a stone being put into a measuring cylinder A containing water. The level of water rose to that shown in cylinder

Use the information to answer the questions that follow.

10. The density of sand is 3 grams per cubic centimeter. Its mass is 270 grams. Find its volume.

$$\text{Density} = \frac{\text{mass}}{\text{volume}} \text{ implies that volume} = \frac{\text{mass}}{\text{density}} = \frac{270}{3} = 90 \text{ cm}^3$$

11. An experiment was done by a P 6 class as shown in the diagram below. **Use it to answer the question that follow**



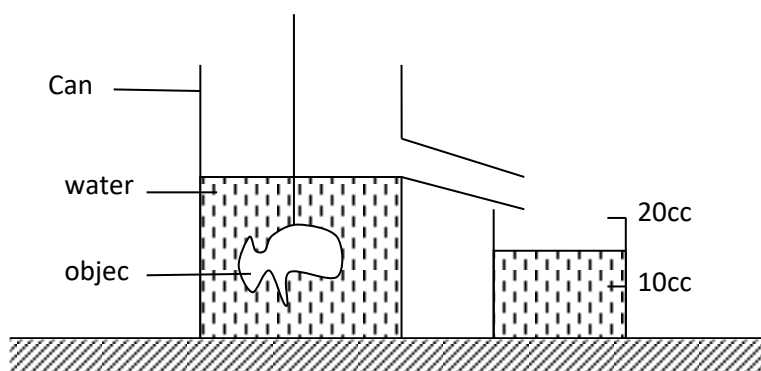
- (a) Work out the volume of the stone.

$$\text{Volume of stone} = 45 - 25 = 20\text{cm}^3$$

- (b) If the density of the stone is 3g/cm^3 , calculate its mass.

$$\text{Mass} = \text{density} \times \text{volume} = 3 \times 20 = 60\text{g}$$

12. An experiment was done by a P 7 class as shown in the diagram below. **Use it to answer the question that follow.**



- (a) When is such a method of finding volume used?

To find the volume of irregular objects

- (b) If the object above has a density of 2g/cm^3 . Find its mass.

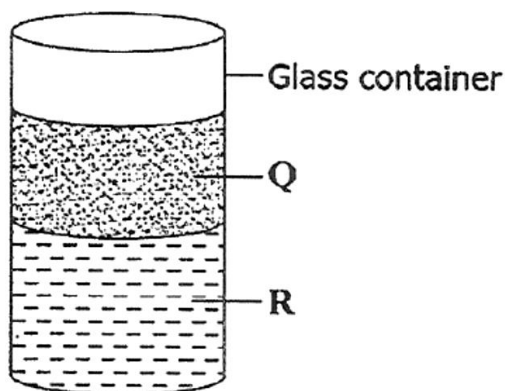
$$\text{Volume} = 15\text{cm}^3$$

$$\begin{aligned}\text{Mass} &= \text{density} \times \text{volume} \\ &= 2 \times 15 = 30\text{g}\end{aligned}$$

13. Why does a nail sink in water?

A nail is denser than water

14. The diagram below shows a glass container into which water and cooking oil were poured. The two liquids settle as shown. Study and use it to answer the questions that follow.



(a) Which of the two liquids is represented by:

Q: **cooking oil**

R: **water**

(b) State any one method that can be used to separate the two liquids

Using a separating funnel

(c) Why has liquid Q settled on top of liquid R?

Q is less dense than R

Thank You

Dr. Bbosa Science